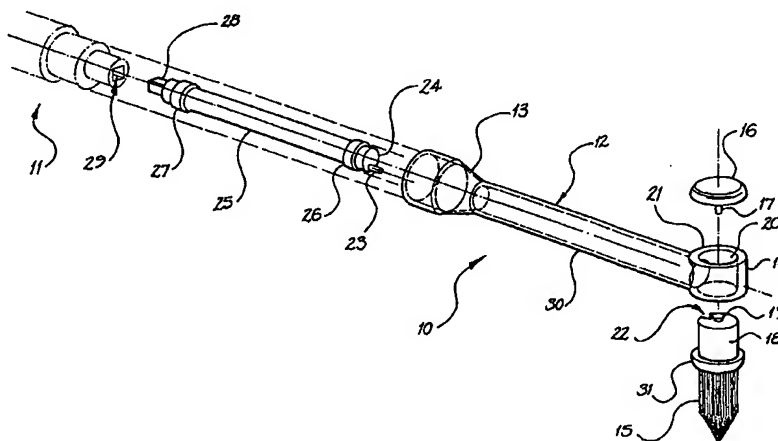




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(54) Title: A DENTAL PROPHYLAXIS HANDPIECE



## (57) Abstract

An electrically driven handpiece (10) is described. The handpiece (10) comprises a shaft (25) one end of which includes a connection means in the form of a shank (28) to accept an aperture (29) in dental handpiece drive (11), the other end of the shaft including a pin (23) with a longitudinal axis parallel to but not on the longitudinal axis of the shaft (25). Bearings (26 and 27) are disposed about the shaft at either end so as to support the shaft (25) in a casing (12) which extends to encompass the shaft (25), the casing (12) including a portion at one end (13) which is enlarged to accept the dental handpiece drive (11) and at the other end a housing (14) into which the pin (23) protrudes. The housing (14) is adapted to retain a member comprising a mounting component (18) and a head (15), which head is disposed outside of the housing (14) and to permit the pin (23) to engage in a groove (22) in the member in a manner such that operation of the dental handpiece drive causes the shaft (25) to rotate which in turn imparts an oscillating arcuate motion to the member including the head (15). Usually the head will comprise an array of bristles (15) for application to dental tissues.

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## A Dental Prophylaxis Handpiece

### Technical Field

5 This invention relates to an apparatus for use in the improvement of oral health especially in dental hygiene and more particularly to a device which may be used by dentists, hygienists and other personnel in relation to the prevention and treatment of dental diseases.

### Background Art

10 Dental diseases include both dental caries (tooth decay) and a group of gum diseases, collectively referred to as "periodontal diseases". The most common aetiological factor or causative agent in both tooth decay and gum diseases is the presence of dental plaque.

Historically, tooth decay was the most common of all human diseases effecting man throughout the world. Tooth decay is the result of  
15 demineralisation of firstly, the outer layer of tooth enamel and then, subsequently, by a similar demineralisation of the inner body of dentine within the tooth. This demineralisation is brought about by an acid attack on the tooth surface. This acid is most commonly derived from acidogenic activity of the microbiological flora within the plaque mass, as the flora  
20 metabolise the carbohydrate content of that same plaque mass, or other sugar compounds within the diet of the host.

However, since the introduction of fluoride into water supplies, toothpastes, drinks, foods, tablets, special solutions and gels applied by the dental professional and through other avenues, the fluoride content of human  
25 tooth enamel has increased to the point where many teeth are now much more resistant to acid attack and so dental caries (tooth decay) has declined in significance and incidence throughout the world.

Nevertheless, this relative "strengthening" of human tooth enamel has not addressed the main cause of dental caries, namely that of the presence of  
30 dental plaque. Thus, more recently there has been an increase in tooth decay on those tooth surfaces which are not covered by human tooth enamel, such as the roots of the tooth.

Moreover, the gums which comprise soft gingival tissue and the collection of periodontal fibres, connective tissue, cementum, periosteum  
35 and bone, commonly referred to as the "periodontal apparatus" and which collectively support and retain the tooth in the mouth, also respond to the

presence of dental plaque, to the point where this entire mechanism may break down and the tooth is lost.

Thus, periodontal or gum diseases themselves have now become amongst the most common of all diseases affecting humans throughout the world today and are now the major cause of adult tooth loss.

Ironically the most common cause of both tooth decay and gum diseases is dental plaque. The diagnosis, treatment and management of these two major dental diseases is within the exclusive domain and responsibility of the dental profession.

However, the control of the primary causative agent, dental plaque, is such an important and/or arduous task, that the profession has introduced a speciality and auxiliary discipline within the profession, called "Dental Hygienists and/or Therapists". An important task of the dental clinician is to remove this damaging substance and to instruct the individual patient how best they can attain control of this menace.

However, the clinical challenge confronting the dentist, hygienist, therapist or other dental clinicians is exacerbated by the limitations of the tools available to them to perform these tasks.

Clearly, the incidence and resultant damage to human health caused by dental plaque would suggest that the profession is failing to address their responsibility in this area and, further, that the tools available to the professional and the patient are inadequate.

The present inventor has thoroughly researched the derivation, accumulation and application of dental plaque. As a direct result of this research, the inventor has designed a system that addresses the very basic requirements of plaque control and this information, technology and appliances form the basis of this patent application.

#### Dental Diseases:

The two most common and significant of all dental diseases are:-

1. Tooth decay - "Dental Caries"
2. Gum diseases - "Periodontal Diseases"

#### Aetiology:

The common primary causative agent to both these diseases is dental plaque.

#### SITES:

1. Local

It is estimated that over 75% of dental diseases commence in between the teeth in the area referred to as the "inter-proximal" region and, more specifically and in the classic model, in an area extending from the point of contact between adjacent teeth to the gingival attachment level at the cemento-enamel junction, where the crown of the tooth meets the root of that tooth. This area may be referred to as the "embrasure triangle".

This site is the most important of all dental disease sites, since it contains both hard (tooth) and soft (gum) tissues and so plaque retention in this area may give rise to both tooth decay and gum disease. This area may be referred to as the "hot spot" of dental diseases.

The next most significant site for dental diseases, especially periodontal diseases is around the gum line on either the outer ("facial", "labial" or "buccal") or inner ("atrial", "palatal" or "lingual") surfaces of each tooth or in the gingival sulcus. This factor may be exacerbated by angled, rotated, tilted, crossed or crowded teeth, all of which facilitate the retention of dental plaque and make its removal more difficult.

The next most significant site in the prevention and treatment of dental caries are the deep fissures, which may occupy an area of the top, biting or "occlusal" surface of the tooth. In these areas, small particles of food and/or plaque may be pushed into these fissures and be difficult to remove with conventional devices. Depending upon the local anatomy, these fissures may also represent a very thin layer of tooth enamel and so be more vulnerable to acid attack.

Similar to the fissures, the next most significant site for dental caries to occur, may be in the anatomical anomalies referred to as "pits". These defects in the tooth enamel are often deep and may occur on either the outer ("facial", "labial" or "buccal") or inner ("lingual", "atrial" or "palatal") surfaces of the tooth.

## 2. Regional

The above sites identify localised areas on or around the tooth and gum surfaces which are prone to most dental disease attack due to the accumulation and retention of dental plaque. It should be noted that dental plaque is generated daily within a normally healthy mouth. It is a sticky, viscous or gelatinous mass that may grow, unless removed effectively.

However, if dental plaque is let accumulate for more than one day, it may calcify to form calculus (sometimes called "tartar"). This is a harder,

chalky mass which binds to the tooth surface and is much more difficult to remove than its softer precursor, dental plaque.

If left to grow and accumulate on the tooth surface, this calculus, being rough attracts more plaque around its mass and so the process continues, the  
5     calculus gets larger and more plaque accumulates around the tooth and/or gum surfaces.

A common source of the calcium necessary for this process to occur is the calcium ions, resident within saliva. Thus, at sites where the saliva enters the mouth and subsequent accumulation of calculus takes place, the  
10     risk of dental diseases commencing is increased. The most common sites so described are the inner surfaces of the lower anterior teeth (lingual surfaces of lower incisors) and the outer surfaces of the upper posterior teeth (buccal surfaces of upper molars). Any other site of surface roughness, which retains plaque, such as defective restorations or anatomical anomalies, also  
15     represents a disease risk site.

The present inventor has recognised that there exists a need for an effective device for the maintenance of oral hygiene and in particular, the maintenance of good periodontal hygiene.

#### **Summary of the Invention**

20     Accordingly, the present invention consists in a dental prophylaxis handpiece comprising a shaft one end of which includes a connection means to accept a dental handpiece drive, the other end of the shaft including a pin with a longitudinal axis either parallel or at an angle to but not on the longitudinal axis of the shaft, one or more bearings disposed about the shaft  
25     so as to support the shaft in a casing which extends to encompass the shaft, the casing including a portion at one end to accept the dental handpiece drive and at the other end a housing into which the pin protrudes, the housing being adapted to retain a member comprising a mounting component and a head, which head is disposed outside of the housing and is  
30     for application to dental tissues, and to permit the pin to engage in a groove in the member in a manner such that operation of the dental handpiece drive causes the shaft to rotate which in turn imparts an oscillating arcuate motion to the member including the head.

In another aspect, the present invention further consists in an  
35     electrically driven handpiece comprising a shaft one end of which is adapted to drivingly connect to an electric motor, the other end of the shaft including

a pin with a longitudinal axis either parallel or at an angle to but not on the longitudinal axis of the shaft, one or more bearings disposed about the shaft so as to support the shaft in a casing which extends to encompass the shaft, the casing including a portion at one end to contain the electric motor and a source of power for the motor and at the other end a housing into which the pin protrudes, the housing being adapted to retain a member comprising a mounting component and a head, which head is disposed outside of the housing and is for application to dental tissues, and to permit the pin to engage in a groove in the member in a manner such that operation of the electric motor causes the shaft to rotate which in turn imparts an oscillating arcuate motion to the member including the head.

Throughout this specification, unless the context requires otherwise, the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

#### Oral Hygiene - In Perspective

##### 1. Inter-Proximal

The inter-proximal region and, in particular, the embrasure triangle, thus represents the most important site in the prophylaxis, or prevention of dental diseases.

However, the motion of conventional "prophylaxis handpieces" and the shape of conventional "prophylaxis heads" are not capable of penetrating this confined and uniquely shaped area. Moreover, even if these devices are forced to penetrate this disease hot spot, their very continuous circular or rotary motion and poor head design may bring about a burning, burnishing and general damage to the local soft tissue, namely the gingival crest.

It should also be noted that the continuous circular or rotary motion of current devices imparts a centrifugal force which tends to propel plaque, blood, puss, bacteria, viruses, pathogens, saliva, oral debris and other matter in a perpendicular direction tangential to the working surface of the rotating head to cause a "splatter" and spread of infectious material and all other matter around the immediate working environment of the device and thereby expose disease transfer risks to all people within that environment.

Not surprisingly, then the profession is not able to address the very demands placed upon it by their responsibility to remove this menace and

thereby prevent what is the most common disease process affecting human health throughout the world today.

Moreover, the continuous circular or rotary motion of current devices invites the device to engage in resistance of tissue surfaces which causes the device to "skid" off these surfaces and "run off" in an uncontrolled direction. Thus the operator must continuously "fight" this dangerous tendency- a factor which causes much frustration, fatigue and fury, let alone exposing the tissue to unnecessary damage.

Clearly, what is needed is a special, purpose built device which is not only capable of penetrating this disease hot spot, but which entertains such a motion that will effectively remove plaque but not cause damage to the tissue, is tissue friendly to both hard and soft tissues, promotes healing and which will actually massage any affected soft tissue back to a state of clinical health whilst not causing "splatter" or spread of any pathogens or infectious matter.

The present inventor believes that the dental prophylaxis handpiece now provided meets this need.

## 2. Gum Line Surfaces

The next most essential ingredient in such an oral hygiene device is that it can effectively clean the gum line of all teeth, again, without causing damage to either the hard or soft tissues and that it should be capable of massaging any affected soft tissue back to clinical health.

The dental prophylaxis handpiece of the invention has been so designed to achieve both inter-proximal hygiene and gum surface debridement simultaneously, to not cause damage to either hard or soft tissue and to massage the soft tissue, all at the same time. This has been achieved by the selection of unique head designs and a sensitive arcuate motion delivered to that head by the unique mechanical design of the handpiece.

Moreover, "splatter" from conventional prophylaxis handpieces has caused so much concern amongst oral health care professionals, that some manufacturers have tried to develop "splatter-free" pastes and have designed special features within the rotating rubber cups to minimise this menacing effect and health care risk, resident within these devices.

In an attempt to combat the spread of infectious material caused by rotating devices, the oral health care profession has been forced to wear protective glasses, face masks, rubber gloves and other expressly protective



utilities. This causes financial and enviromental burden which may be reduced through the use of the present invention.

### 3. Occlusal Surface Fissures

5 The occlusal surfaces, together with their deep fissures are difficult to clean with conventional rubber cups, bristle brushes and the common circular motion as is currently available through regular dental handpieces.

The present invention has been proven to be more efficient in terms of time and extent of debridement it performs in these often difficult to get to areas. Further, the preparation of the fissures for the preventive procedure referred to as "fissure sealing" is much more enhanced by the use of the present invention. Again, this feature is due to the exclusive design of the heads and the arcuate motion delivered to those heads by this handpiece.

### 4. Coronal Pits

15 Indeed most coronal abnormalities are difficult to clean, when using conventional prophylaxis handpieces. Especially, rubber cups are not capable of engaging these defects.

The unique head design and arcuate motion of the heads of the present invention has shown to be most effective in the debridement of these dental defects.

### 20 5. Intervention

The above features refer to prevention of the disease process. However, since dental diseases are often already under way in many patient's mouths, the need for effective intervention is obvious. Unfortunately, the conventional prophylaxis handpieces are not capable of performing this important task, without considerable risk of further damage being imposed upon the very tissue we are trying to treat. This device performs this task as well.

The shaft of the handpiece may be circular or multi-sided in cross-sections. Preferably, the shaft is circular in cross-section.

30 In the event that a multi-sided shaft is chosen, it is important that such a shaft generally include one or more portions which are circular in section to allow for the disposition of one or more bearings to support the shaft in the casing. Alternatively, a ball bearing with a suitably shaped inner surface to correspond with the cross-sectional shape of the shaft may be used.

35 Generally, irrespective of whether the shaft is circular or multi-sided in cross-section, two bearings will be used to support the shaft, a first bearing

disposed about the shaft proximate the one end of the shaft and the second bearing about the shaft proximate the other end of the shaft.

For reasons of durability, it is desirable that the shaft is made of metal, although plastics materials may be used. The person skilled in the art would  
5 recognise that a variety of metals may be used including stainless steel, mild steel and other alloys.

Similarly, usually the one or more bearings will be made of metal, although plastics materials could be used. The material of construction and the design of the bearings need to be consistent with amongst other things,  
10 the rotational speed of the shaft. Examples of suitable bearings are journal bearings, roller bearings and ball bearings.

The connection means may comprise a slot in a face of the one end of the shaft. This slot may be multi-sided in cross-section.

Alternatively, the connection means may comprise a shank which  
15 projects out of a face of the one end of the shaft. This shank may be multi-sided in cross-section.

The nature of the connection means will be determined by the kind of dental handpiece drive used. To allow for maximum utility of the handpiece of the invention, the slot is arrayed to accept a drive from those drives that  
20 are used in the dental profession. These drives include handpiece drives such as Doriot, E-type, Borden and mid-west including that imparted by a piece intermediate between the dental motor drive and the disposable handpiece commonly referred to as a "nose cone". Note, however, that the shaft may be dimensioned or configured in any way to accept any drive.

Furthermore, the handpiece drive may rotate clockwise or  
25 anticlockwise at conventional speeds of 0-40,000rpm. Gearing may be included so as to reduce the final rotation speed to 0-5,000rpm from 0-40,000rpm.

In the electrically driven handpiece aspect of the invention, the shaft is  
30 adapted to drivingly connect to an electric motor. This may occur by a variety of means including direct coupling to the shaft of the electric motor or through an appropriate combination of gears mounted on each shaft. The person skilled in the art will also recognise that a common shaft may used. In this embodiment, a single shaft projects out of the electric motor.

The other end of the shaft includes a pin having a longitudinal axis  
35 which is either parallel or at an angle to but not on the longitudinal axis of

the shaft. Preferably the pin is mounted on a face of the other end of the shaft. Although dependant on the diameter of the shaft, preferably the pin will be about 1-3mm from the centre of the shaft, most preferably about 2mm. Preferably the pin will have a width of between about 1 and 2mm, most preferably about 1.5mm. Alternatively, the pin may be tapered with the widest dimension on the shaft.

A casing is used to contain the shaft and to provide a mounting for the bearing(s). The casing may be made from a variety of plastics materials and metals. In general terms, casings formed from metal, such as aluminium and its alloys, stainless steel and the like will be more durable and are capable of sterilisation by accepted means thereby allowing for reuse. Likewise, single use or disposable handpieces, when required, may be formed from less durable plastics material such as polypropylene, polycarbonates, or combinations thereof or any other plastic resin material.

To assist in assembly, the casing may be formed from two halves. In such an embodiment, the halves are preferably formed in longitudinally extending portions. The half portions will have suitable mating surfaces with means being provided to join the halves together. Such means may include one or more fasteners which pass through opening(s) in one half to mate with suitable receptacle(s) in the other half. For example, the fasteners may be screws with the receptacle(s) having corresponding portions to accept the screw thread.

Alternatively, the casing may be formed in one piece. For example, when made from synthetic plastics material, the casing may be injection or blow moulded.

In the electrically driven handpiece aspect, the casing also contains the electric motor and power source. For convenience, the power source may be one or more batteries, optionally rechargeable. Alternatively, the power source may comprise a suitable plug or socket for connection to a domestic power supply. In any event, preferably a switch will be mounted in or on the casing to allow for power to be supplied to the electric motor as required.

In one embodiment, the casing may be enlarged at the one end so as to more easily accept the dental handpiece drive. The portion of the casing between the enlarged section and the housing may be substantially cylindrical in shape, tapered or contra-angled. If tapered, the casing will taper inwardly from the enlarged section towards the housing. Note that the

taper may be over a full or a part length of the casing. When part tapered, a substantially cylindrical portion of the casing will be adjacent the housing.

When the casing is contra-angled, generally a portion of the casing adjacent the enlarged section will be substantially cylindrical or tapered with the portion of the casing adjacent the housing contra-angled. In this context, "contra-angled" refers to the acute angle formed between the longitudinal axis of the substantially cylindrical portion of the casing and the longitudinal axis of the contra-angled portion of the casing. Such a contra-angle is desirable as existing dental devices utilise this feature.

It follows that in embodiments that include a contra-angled casing, the shaft will comprise two shaft components. A first shaft component will include the connection means at one end and a first coupling means at the other end. The first shaft component will extend along the longitudinal axis of the substantially cylindrical portion. A second shaft component will include a second coupling means at one end and the pin at the other end. The second shaft component will extend along the longitudinal axis of the contra-angled portion.

Both the first and the second component shafts will be mounted in the casing on one or more bearings as appropriate in a manner such that the first and the second coupling means are in driving engagement. Similarly the shafts may engage any number of gears in order to reduce its final rotational speed from 0-40,000 rpm to 0-5,000 rpm or any speed in between 0-40,000 rpm.

Although the person skilled in the art will recognise that a variety of coupling means may be used, one preferred coupling means is the combination of a crown gear and a pinion gear. In this invention, the first coupling means and the second coupling means could be a combination of either gear.

It is also desirable that the casing be provided with a means on an outer surface thereof to enhance control and/or comfort of the handpiece. Such means may comprise flattened portions to form a casing having a polygonal cross-section or sunken grip points. Alternatively, raised portions may be provided on the outer surface of the casing for the same purpose.

The handpiece includes a housing into which the pin protrudes. This housing is adapted to retain a member which comprises a mounting

component and a head. The head is disposed outside of the housing and is for application to dental tissue.

5 In protruding into the housing, the pin must be engageable with a groove in the mounting component such that operation of the dental handpiece drive causes the shaft to rotate which in turn imparts an oscillating arcuate motion to the member, including the head. The arcuate angle will usually be up to 90°, preferably up to about 45°.

10 Generally, the housing will be substantially cylindrical in shape. Preferably, the longitudinal axis of the housing is at an angle of between about 90° and about 125° with respect to the longitudinal access of the shaft. For ease of construction, the housing will usually be formed as an integral part of the casing.

15 The member, including the head, retained by the housing comprises a mounting component and a head. Preferably the mounting component is substantially cylindrical and is in sliding contact with an inner surface of the housing. Alternatively, the mounting component may have one or more bearing surfaces to engage an inner surface of the housing.

20 In a preferred embodiment, the pin engages in a groove which is disposed in the mounting component such that the groove extends in a plane through the longitudinal axis of the member. The groove may extend completely or partially along the member.

In another embodiment, the groove may extend in a plane through the transverse axis of the member. Again, the groove may extend completely or partially along the member.

25 In an embodiment wherein the mounting component is substantially cylindrical, preferably it is in frictional engagement with a surface of the housing so as to retain the member therein. This may be achieved by providing a rim formed on an upper surface of the mounting component, the rim bearing on an upper edge of the housing so as to retain the member in the housing.

30 Alternatively, the member may include a second groove in the mounting component, the groove extending transversely to engage a second pin disposed within the housing so as to retain the member therein.

35 Similarly any other means of retaining the member within the housing may be used, such as a latch or any other effective retention piece both in the member or the housing.

The present inventor has discovered that the width of the groove and the angles of its walls, together with the eccentricity of the pin directly affect the amplitude of the arc of the member, including the head particularly under light loading. By "eccentricity of the pin" it is meant the extent to which the pin is positioned away from the longitudinal axis of the shaft. However, when the head is loaded whilst in use in a narrow or tight space, this amplitude reduces considerably. This difference in amplitude of the arcuate oscillation is referred to in this specification as the "tidal load slap" this factor has proven to be an advantage, especially when dealing with the wide variations in the degree of dental crowding, gaps between teeth and the degree of massage necessary to effectively treat some gum conditions. This degree of tidal load slap also acts as a buffer to reduce any aggressive movement of the head and thereby minimise damage to the dental tissue.

Accordingly, it is preferred that the external width of the groove is about from 1mm to 3mm. Most preferably about 2mm.

Similarly, the internal width of the groove is preferably about 0.5mm to 2mm, most preferably about 1mm.

The depth of the groove is preferably about 1mm to 3mm, most preferably about 2mm. In some embodiments, it may extend within the mounting component to be continuous with a hollow central portion formed therein.

The groove may have parallel sides or be flared internally or externally. In this context flaring internally refers to embodiments where the external width of a groove is less than the internal width of a groove. Similarly, flaring externally refers to embodiments where the external width of a groove is greater than the internal width of a groove.

Alternatively, the pin may be tapered and the groove angled to form a V-shape so that the internal surface of the groove engages the tapered surface of the pin at all times.

It will be appreciated that the mounting component and head may be integrally formed, formed separately and permanently joined or formed separately and separably joined. The advantage in providing a separably joinable head is that it allows for ready replacement.

As previously mentioned, the member comprises a mounting component and a head. The head is disposed outside of the housing and is for application to dental tissues.

Generally, a head will comprise an array of bristle brushes which are mounted on a base. The base may comprise or function as the mounting component.

5 The design of the bristle brushes will be such that the head is capable of penetrating the inter-proximal area and in particular the embrasure triangle as well as into deeper periodontal pockets and other dental tissues relevant to the formation of plaque or other dental disease activity.

10 Generally, the topographical trim of the heads may be pyramidal, conical, V-shaped, dished, domed triangular, square or a combination of these shapes. The angle of the topographical trim may vary from about  $40^\circ$  to about  $80^\circ$  with respect to the base of the head. This angle is critical to allow maximum penetration and activity within the range of naturally occurring inter-proximal areas.

15 In one preferred embodiment, the head comprises tufts of bristles mounted in the base and made from 600 series nylon. These provide ideal flexibility for general hygiene purposes, sufficient rigidity to remove dental plaque but are sufficiently resilient to provide a gentle massaging effect on the gums. This series of nylon are also more resistant to moisture contamination. Preferably, the length of bristles is between about 5mm and  
20 about 15mm with the average height of the highest bristles in the peak being about 10mm.

In this embodiment, the number of bristles per tuft and the number of tufts per unit area of the base are important. In a preferred embodiment, there are 25 bristles per tuft but as required, this may vary from between 15  
25 to 40 bristles per tuft. For this preferred embodiment, the tuft is about 1.5mm diameter at the base. However, the diameter may vary from between about 1 to about 2mm. In a particularly preferred embodiment, there is one tuft of bristles per 2mm squared. However, this may vary from between one tuft per  $\text{mm}^2$  to one tuft per  $4\text{mm}^2$ . This variation is necessary to cater for  
30 the wide variation in dental crowding arising from those people with wide gaps between the teeth to those which are crossed, crowded or tilted.

For guidance, the base of a single peaked head is about  $7\text{mm}^2$ . However, this may vary from about  $5\text{mm}^2$  to  $10\text{mm}^2$ .

35 In an alternative embodiment, the bristles may be arranged as a single tuft or mass rather than as one or more tufts.

Alternatively, the bristles may be made from any other nylon, plastics material, natural or synthetic material to provide filaments similar to those previously described as bristles.

In a further alternative embodiment, rather than in the form of bristles, the head may comprise a shape formed from a flexible or absorbent material such as rubber, silicone, synthetics plastics materials, felt, condensed paper, cork or wood. These heads may be used to apply medications to affected dental tissues either separately or simultaneously with the removal of dental plaque. Suitable shapes include conical and triangular pyramidal.

As previously mentioned, various components of the handpiece of the invention may be made of metal, plastics materials or mixtures thereof. In general terms, those hand pieces made of plastics will be disposable, that is for single use. In one embodiment formed from plastics materials, the head may be non-removably incorporated in the hand piece. Alternatively, the head may be removable as previously described. Amongst the plastics materials that may be used are polypropylenes, polycarbonates and the like, mixtures thereof or any other suitable plastics materials.

In plastic handpieces of the invention the bearing(s) may exist as simple surface contact areas or any other form of bearing detail. Thus these bearings may be integral or separate from the shaft.

Those hand pieces formed from metal components will generally be reusable, that is they will be capable of cleaning and sterilisation.

For those embodiments formed from both plastics materials and metal components, it is possible to produce embodiments that are either reusable, disposable or both according to choice. However, in producing reusable composite hand pieces it is important to consider the nature of the plastics materials used to ensure that they are capable of being sterilised.

#### Brief Description of Drawings

Figure 1 is a perspective view of a first dental prophylaxis handpiece of the invention;

Figure 2 is an exploded view of the dental prophylaxis handpiece of figure 1;

Figure 3 is a sectional view about A-A of figure 1;

Figure 3a is a partial sectional view of an alternate pin and shaft arrangement;

Figure 3b is a partial sectional view of a further alternate pin and shaft



arrangement;

Figure 4 is a sectional view about B-B of figure 1;

Figure 5 are end sectional views of six embodiments of one end of the shaft showing various connection means;

5 Figure 6 are partial perspective views of three embodiments of the housing;

Figures 7a, 7b, 7c, 7f and 7g are perspective views of five embodiments of the mounting components, whilst figures 7d and 7e are perspective views of two embodiments of the member;

10 Figures 8a, 8b and 8c are respectively perspective, side elevational and end elevational views of one embodiment of a head;

Figures 8d-8j are perspective views of seven further embodiments of the head;

15 Figure 9 are schematic views illustrating positioning of various heads in relation to dentition; and

Figure 10 is a side elevational view of an alternative embodiment of the casing.

#### Modes for Carrying Out the Invention

20 In order to better understand the nature of this invention, a number of embodiments will now be described with reference to the abovementioned drawings.

The dental prophylaxis handpiece 10 comprises a casing 12, one end 13 of which is enlarged to accept a dental handpiece drive 11, whilst the other end includes a substantially cylindrical housing 14.

25 Between the end 13 and the housing 14, the casing 12 includes a cylindrical portion 30. In this embodiment the casing is moulded in one piece from synthetic plastics material.

30 Disposed within the casing 12 is a shaft 25 which is circular in cross-section. The shaft 25 is retained within the casing 12 by virtue of journal bearing 27 which is disposed towards the one end of the shaft 25 and journal bearing 26 which is disposed towards the other, housing 14 end.

At the one end of shaft 25 is a connection means which comprises a shank 28. An aperture 29 formed in the dental handpiece drive 11 is dimensioned to accept shank 28 therein.

At the other end of shaft 25 is a pin 23 which extends from the face 24 of the shaft with a longitudinal axis parallel thereto. The pin 23 is offset from the longitudinal axis of the shaft and projects into housing 14.

5 In the alternative arrangement shown in figure 3a, the pin 32 is disposed at an angle of 45° to the longitudinal axis of the shaft 25.

In the further alternative arrangement shown in figure 3b, the pin 33 is also disposed at an angle of 45° to the longitudinal axis of the shaft 25. For this arrangement, the pin 33 tapers from its widest dimension where it extends from the face 24 of the shaft to its narrowest dimension distal the  
10 face.

Retained within housing 14 is a member comprising a mounting component 18 and a head 15. The mounting component 18 slidably fits within housing 14 such that pin 23 engages in a groove 22 formed therein. In this embodiment, the groove 22 extends in a plane through the longitudinal  
15 axis of the mounting component 18. More particularly, the groove 22 has an external width of 2mm and an internal width of 1mm. The depth of the groove 22 is 2mm.

To retain the member in the housing 14, the mounting component 18 is provided with a circumferential ledge 31 having a diameter greater than  
20 the diameter of housing 14. At an upper end of the mounting component 18 is a slot 19 which is adapted to accept a retaining cover 16 having a pin 17. Retaining cover 16 also has a diameter greater than the diameter of housing 14 and when assembled, pin 17 is cemented into slot 19 such that the retaining cover bears on upper surface 21 of housing 14.

25 Although housing 14 may be disposed with its longitudinal axis at an angle  $\alpha$  of between about 90° and about 120° with respect to the longitudinal axis of the shaft 25, in this embodiment the angle is 90°.

Whilst a variety of heads may be used in this invention, head 15 comprises a frustoconical shape formed from tufts of bristles. Whilst the  
30 bristles may vary in length from between about 5mm and about 15mm, in this embodiment the highest bristles are about 10mm in length. In this embodiment the bristles are formed from 600 series nylon.

In use, activation of the dental handpiece drive 11 causes shaft 25 to rotate which in turn results in the member comprising the mounting  
35 component and head moving in an oscillating arcuate motion.

In figure 10, there is shown an alternative embodiment of the casing for a handpiece of the invention. This handpiece 125 comprises a casing which includes an enlarged portion 128 and a portion 127 tapering from the enlarged portion towards a contra-angled portion 126. Housing 129 is  
5 adjacent portion 126.

Along the tapered part of the casing 127, there are a plurality of facets 130 and raised spots 131 so as to enhance gripping.

Referring now to figure 5, there are shown six end sectional views of various connection means to accept a dental handpiece.

10 In each embodiment, the shaft 51 has a slot shown as 52 in figure 5a, 53 in figure 5b, 54 in figure 5c, 55 in figure 5d, 56 in figure 5e and 57 in figure 5f.

Each of the slots 52, 53, 54, 55, 56 and 57 are shaped so as to accept various standard dental handpiece drives. Thus the handpiece drive would  
15 have a shank having a matching shape so as to slidingly fit into a like slot.

It will of course be recognised by a person skilled in the art, that the shaft may be provided with a shank and the handpiece drive provided with a corresponding shape matching slot.

In figure 6 there are shown three embodiments of the housing in which  
20 the housing is disposed at different angles to the casing.

Thus, in figure 6a housing 61 has its longitudinal axis at  $90^\circ$  with respect to the longitudinal axis of the casing 62.

In figure 6b, the housing has its longitudinal axis at about  $100^\circ$  with respect to the longitudinal axis of the housing 63.

25 In figure 6c, the longitudinal axis of the housing 66 is at an angle of about  $120^\circ$  with respect to the longitudinal axis of the casing 65.

In figures 7a, 7b, 7c, 7f and 7g there are shown five embodiments of the mounting component.

Referring to figure 7a, the mounting component 71 is substantially  
30 cylindrical in shape with a groove 72 extending between a lower face 74 and an upper face 73. Groove 72 has walls 76, 77 which slope inwardly to an inner wall 75 such that the width at the opening of the groove, ie the distance between walls 76 and 77, is greater than the width of the wall 75.

In figure 7b, where like parts have been numbered the same as figure  
35 7a, in place of upper face 73 there is an enlarged face 78 having a

circumferential ledge 79. The ledge 79 is dimensioned such that when placed into a housing, the ledge retains the mounting component therein.

In figure 7c, a similar embodiment to that of figure 7a is shown with the addition of a second groove 80. This groove 80 is adapted to engage a second pin disposed within the housing so as to retain the member in the housing.

In figure 7f, groove 88 has walls 89 which flare inwardly such that the external width of the groove is less than the internal width of the groove.

In figure 7g, groove 86 has walls which slope inwardly, such the groove is continuous with a hollow central portion 87 formed in the mounting component 71.

In figure 7d there is shown the mounting component of 7a together with a head comprising a base 81 and an array of bristles 82. In this embodiment, the base has been cemented to the mounting component 71.

In figure 7e, there is shown another member in which the head comprises a base 85 and upstanding bristles 82. In this embodiment, the base 85 includes an aperture 84 which when joined with mounting component 71 matches with a corresponding aperture 83 therein. By inserting a sliding latch into apertures 83 and 84, the head is retained on the mounting component. Removal of the latch, allows the head to be readily separated from the mounting component.

In figures 8a, 8b and 8c there is shown a head 91 which comprises an array of upstanding tufts of bristles 92 mounted in a base 91. In this embodiment, the bristles are shaped into two side by side square rectangular shapes.

The bristles are formed from 600 series nylon with the height of the highest bristles in the peak being about 10mm. There are 25 bristles per tuft with the tufts being about 1.5mm diameter at the base.

In figure 8d there is shown another embodiment of a head 94 comprising a base 95 and upstanding bristles 96. In this case there is a single square pyramidal shape. The specification for the bristles is the same as for the bristles of figures 8a, 8b and 8c.

Similarly, in figures 8e and 8f there are shown a further two embodiments of a head comprising respectively bases 98 and 101 and upstanding bristles 99 and 102.

In the embodiment of figure 8e, the bristles are in a V-shape whilst in the case of figure 8f, the bristles are in the shape of a cone.

In figures 8g and 8h, alternative embodiments of the head are shown. In figure 8g, head 103 comprises a base 104 and a conical portion 105  
5 mounted on the base. The conical portion 105 is formed from silicone and may be used for example for removing plaque.

Similarly, the head 106 of figure 8h comprises a base 107 and a triangular pyramidal shape 108. Again, the pyramidal shape 108 is formed from silicone and may be used for removing plaque.

10 For both of the embodiments shown in figures 8g and 8h, the shaped portions 105 and 108 may be provided with a plurality of ribs, fluting or undulating surface features.

In figure 8i, the head 109 comprises a base 110 and a spiral array of bristles 111.

15 In figure 8j, there is shown a second embodiment of a head incorporating a spiral array of bristles 104 mounted in a base 113. In this embodiment the array of bristles has an overall conical shape.

In figure 9a, there is schematically shown the interaction between heads 91, 94 and dentition generally shown as 120.

20 Similarly in figure 9b there is shown the interaction of heads 109 and 112 with dentition generally shown as 120.

In both figures, it is evident that the heads are able to readily access the inter-proximal areas of the dentition.

25 It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

## CLAIMS

1. A dental prophylaxis handpiece comprising a shaft one end of which includes a connection means to accept a dental handpiece drive, the other  
5 end of the shaft including a pin with a longitudinal axis either parallel or at an angle to but not on the longitudinal axis of the shaft, one or more bearings disposed about the shaft so as to support the shaft in a casing which extends to encompass the shaft, the casing including a portion at one end to accept the dental handpiece drive and at the other end a housing into which the pin  
10 protrudes, the housing being adapted to retain a member comprising a mounting component and a head, which head is disposed outside of the housing and is for application to dental tissues, and to permit the pin to engage in a groove in the member in a manner such that operation of the dental handpiece drive causes the shaft to rotate which in turn imparts an  
15 oscillating arcuate motion to the member including the head.
2. A dental prophylaxis handpiece as claimed in claim 1 wherein the shaft has a circular or a multi-sided cross-section.
3. A dental prophylaxis handpiece as claimed in claim 2 wherein the  
20 shaft is multi-sided and is provided with one or more portions each of which is circular in cross-section and adapted to accept a bearing.
4. A dental prophylaxis handpiece as claimed in claim 2 wherein the shaft is multi-sided and is provided with one or more ball bearings each of which is shaped internally so as to correspond with the cross-sectional shape of the shaft.
- 25 5. A dental prophylaxis handpiece as claimed in claim 2 wherein the shaft has a circular cross-section.
6. A dental prophylaxis handpiece as claimed in any one of claims 1 to 5 wherein the connection means comprises a slot in a face of the one end of the shaft.
- 30 7. A dental prophylaxis handpiece as claimed in claim 6 wherein the slot is multi-sided in cross-section.
8. A dental prophylaxis handpiece as claimed in claim 6 wherein the slot is arrayed to accept a drive selected from the group consisting of Doriot, E-type, Borden and mid-west.

9. A dental prophylaxis handpiece as claimed in any one of claims 1 to 5 wherein the connection means comprises a shank which projects out of a face of the one end of the shaft.
10. A dental prophylaxis handpiece as claimed in any one of claims 1 to 9 wherein a first bearing is disposed about the shaft proximate the one end of the shaft and a second bearing disposed about the shaft proximate the other end of the shaft.
12. A dental prophylaxis handpiece as claimed in any one of claims 1 to 11 wherein the pin is mounted on a face of the other end of the shaft.
13. A dental prophylaxis handpiece as claimed in claim 12 wherein the pin is located about 1-3mm from the centre of the shaft, preferably about 2mm.
14. A dental prophylaxis handpiece as claimed in 13 wherein the pin has a diameter of between about 1 and 2mm, preferably about 1.5mm.
15. A dental prophylaxis handpiece as claimed in any one of claims 1 to 14 wherein the portion of the casing to accept the dental handpiece drive is enlarged.
16. A dental prophylaxis handpiece as claimed in any one of claims 1 to 15 wherein the casing is substantially cylindrical in shape, tapered or contra-angled between the enlarged section and the housing.
17. A dental prophylaxis handpiece as claimed in claim 16 wherein the casing tapers inwardly from the enlarged section towards the housing.
18. A dental prophylaxis handpiece as claimed in claim 17 wherein the taper is over a part length of the casing.
19. A dental prophylaxis handpiece as claimed in claim 16 wherein the casing adjacent the housing is contra-angled, with the remainder of the casing either tapered or substantially cylindrical in shape.
20. A dental prophylaxis handpiece as claimed in claim 19 wherein the shaft comprises two shaft components, a first shaft component including the connection means at one end and a first coupling means at the other end, the first shaft component extending along the longitudinal axis of the substantially cylindrical portion and a second shaft component including a second coupling means at one end and the pin at the other end, the second shaft component extending along the longitudinal axis of the contra-angled portion with the first and the second coupling means being in driving engagement.

21. A dental prophylaxis handpiece as claimed in claim 20 wherein the first coupling means and the second coupling means comprise a crown gear and a pinion gear.
22. A dental prophylaxis handpiece as claimed in any one of claims 1 to 21  
5 wherein the casing is provided with a means on an outer surface thereof to enhance control and/or comfort of the handpiece.
23. A dental prophylaxis handpiece as claimed in claim 22 wherein the means comprise flattened or raised portions to form a casing having a polygonal cross-section or sunken or raised grip points.
- 10 24. A dental prophylaxis handpiece as claimed in any one of claims 1 to 23 wherein the housing is substantially cylindrical.
25. A dental prophylaxis handpiece as claimed in claim 24 wherein the longitudinal axis of the housing is at an angle of between about 90° and about 125° with respect to the longitudinal axis of the shaft.
- 15 26. A dental prophylaxis handpiece as claimed in claim 25 wherein the mounting component is substantially cylindrical and is in sliding contact with an inner surface of the housing.
27. A dental prophylaxis handpiece as claimed in claim 26 wherein the groove extends in a curved surface in a plane through the longitudinal axis of  
20 the member.
28. A dental prophylaxis handpiece as claimed in claim 25 wherein the groove extends in a curved surface in a plane through the transverse axis of the member.
29. A dental prophylaxis handpiece as claimed in claim 28 wherein the  
25 cylindrical portion is in frictional engagement with the inner surface of the housing so as to retain the member.
30. A dental prophylaxis handpiece as claimed in claim 29 wherein a rim is formed on an upper surface of the member, the rim bearing on an upper edge of the housing so as to retain the member in the housing.
- 30 31. A dental prophylaxis handpiece as claimed in claim 27 wherein the member includes a second groove which extends transversely to engage a second pin disposed within the housing to retain the member.
32. A dental prophylaxis handpiece as claimed in any one of claims 1 to 31  
35 wherein the groove has an external width of about 1mm to about 3mm, preferably about 2mm.



33. A dental prophylaxis handpiece as claimed in any one of claims 1 to 32 wherein the groove has an internal width of about 0.5mm to about 2mm, preferably about 1mm.

34. A dental prophylaxis handpiece as claimed in any one of claims 1 to 33  
5 wherein the groove has a depth of about 1mm to about 3mm, preferably about 2mm.

35. A dental prophylaxis handpiece as claimed in any one of claims 1 to 34 wherein the head is separably joined to the mounting component.

36. A dental prophylaxis handpiece as claimed in any one of claims 1 to 35  
10 wherein the head is joined to the mounting component.

37. A dental prophylaxis handpiece as claimed in any one of claims 1 to 36 wherein the head comprises an array of bristle brushes mounted on a base.

38. A dental prophylaxis handpiece as claimed in any one of claims 1 to 36  
15 wherein the head comprises a shape formed from a flexible or absorbent material.

39. A dental prophylaxis handpiece as claimed in claim 38 wherein the head is provided with a plurality of ribs, fluting or undulating surface features.

40. A dental prophylaxis handpiece as claimed in any one of claims 1 to 39  
20 wherein the angle of the oscillating arcuate motion of the head is up to 90°, preferably up to 45°.

41. An electrically driven handpiece comprising a shaft one end of which is adapted to drivingly connect to an electric motor, the other end of the shaft including a pin with a longitudinal axis either parallel or at an angle to but  
25 not on the longitudinal axis of the shaft, one or more bearings disposed about the shaft so as to support the shaft in a casing which extends to encompass the shaft, the casing including a portion at one end to contain the electric motor and a source of power for the motor and at the other end a housing into which the pin protrudes, the housing being adapted to retain a member  
30 comprising a mounting component and a head, which head is disposed outside of the housing and is for application to dental tissues, and to permit the pin to engage in a groove in the member in a manner such that operation of the electric motor causes the shaft to rotate which in turn imparts an oscillating arcuate motion to the member including the head.

35 42. An electrically driven handpiece as claimed in claim 41 wherein the shaft has a circular or a multi-sided cross-section.

43. An electrically driven handpiece as claimed in claim 42 wherein the shaft is multi-sided and is provided with one or more portions each of which is circular in cross-section and adapted to accept a bearing.

5 44. An electrically driven handpiece as claimed in claim 42 wherein the shaft is multi-sided and is provided with one or more ball bearings each of which is shaped internally so as to correspond with the cross-sectional shape of the shaft.

45. An electrically driven handpiece as claimed in claim 42 wherein the shaft has a circular cross-section.

10 46. An electrically driven handpiece as claimed in any one of claims 41 to 45 wherein the shaft is directly coupled to the electric motor.

47. An electrically driven handpiece as claimed in any one of claims 41 to 45 wherein the shaft projects out of the electric motor.

15 48. An electrically driven handpiece as claimed in any one of claims 41 to 45 wherein the shaft is drivingly connected to the electric motor through intermediate gears.

20 49. An electrically driven handpiece as claimed in any one of claims 41 to 48 wherein a first bearing is disposed about the shaft proximate the one end of the shaft and a second bearing disposed about the shaft proximate the other end of the shaft.

50. An electrically driven handpiece as claimed in any one of claims 41 to 49 wherein the pin is mounted on a face of the other end of the shaft.

25 51. An electrically driven handpiece as claimed in claim 50 wherein the pin is located about 1-3mm from the centre of the shaft, preferably about 2mm.

52. An electrically driven handpiece as claimed in 51 wherein the pin has a diameter of between about 1 and 2mm, preferably about 1.5mm.

30 53. An electrically driven handpiece as claimed in any one of claims 41 to 52 wherein the portion of the casing to accept the dental handpiece drive is enlarged.

54. An electrically driven handpiece as claimed in any one of claims 41 to 53 wherein the casing is substantially cylindrical in shape, tapered or contra-angled between the enlarged section and the housing.

35 55. An electrically driven handpiece as claimed in claim 54 wherein the casing tapers inwardly from the enlarged section towards the housing.

56. An electrically driven handpiece as claimed in claim 55 wherein the taper is over a part length of the casing.
57. An electrically driven handpiece as claimed in claim 55 wherein the casing adjacent the housing is contra-angled, with the remainder of the casing either tapered or substantially cylindrical in shape.
58. An electrically driven handpiece as claimed in claim 57 wherein the shaft comprises two shaft components, a first shaft component including the connection means at one end and a first coupling means at the other end, the first shaft component extending along the longitudinal axis of the substantially cylindrical portion and a second shaft component including a second coupling means at one end and the pin at the other end, the second shaft component extending along the longitudinal axis of the contra-angled portion with the first and the second coupling means being in driving engagement.
59. An electrically driven handpiece as claimed in claim 58 wherein the first coupling means and the second coupling means comprise a crown gear and a pinion gear.
60. An electrically driven handpiece as claimed in any one of claims 41 to 59 wherein the casing is provided with a means on an outer surface thereof to enhance control and/or comfort of the handpiece.
61. An electrically driven handpiece as claimed in claim 60 wherein the means comprise flattened or raised portions to form a casing having a polygonal cross-section or sunken or raised grip points.
62. An electrically driven handpiece as claimed in any one of claims 41 to 61 wherein the housing is substantially cylindrical.
63. An electrically driven handpiece as claimed in claim 62 wherein the longitudinal axis of the housing is at an angle of between about 90° and about 125° with respect to the longitudinal axis of the shaft.
64. An electrically driven handpiece as claimed in claim 63 wherein the mounting component is substantially cylindrical and is in sliding contact with an inner surface of the housing.
65. An electrically driven handpiece as claimed in claim 64 wherein the groove extends in a curved surface in a plane through the longitudinal axis of the member.

66. An electrically driven handpiece as claimed in claim 65 wherein the groove extends in a curved surface in a plane through the transverse axis of the member.

5 67. An electrically driven handpiece as claimed in claim 66 wherein the cylindrical portion is in frictional engagement with the inner surface of the housing so as to retain the member.

68. An electrically driven handpiece as claimed in claim 67 wherein a rim is formed on an upper surface of the member, the rim bearing on an upper edge of the housing so as to retain the member in the housing.

10 69. An electrically driven handpiece as claimed in claim 65 wherein the member includes a second groove which extends transversely to engage a second pin disposed within the housing to retain the member.

70. An electrically driven handpiece as claimed in any one of claims 41 to 69 wherein the groove has an external width of about 1mm to about 3mm, preferably about 2mm.

71. An electrically driven handpiece as claimed in any one of claims 41 to 70 wherein the groove has an internal width of about 0.5mm to about 2mm, preferably about 1mm.

20 72. An electrically driven handpiece as claimed in any one of claims 41 to 71 wherein the groove has a depth of about 1mm to about 3mm, preferably about 2mm.

73. An electrically driven handpiece as claimed in any one of claims 41 to 72 wherein the head is separably joined to the mounting component.

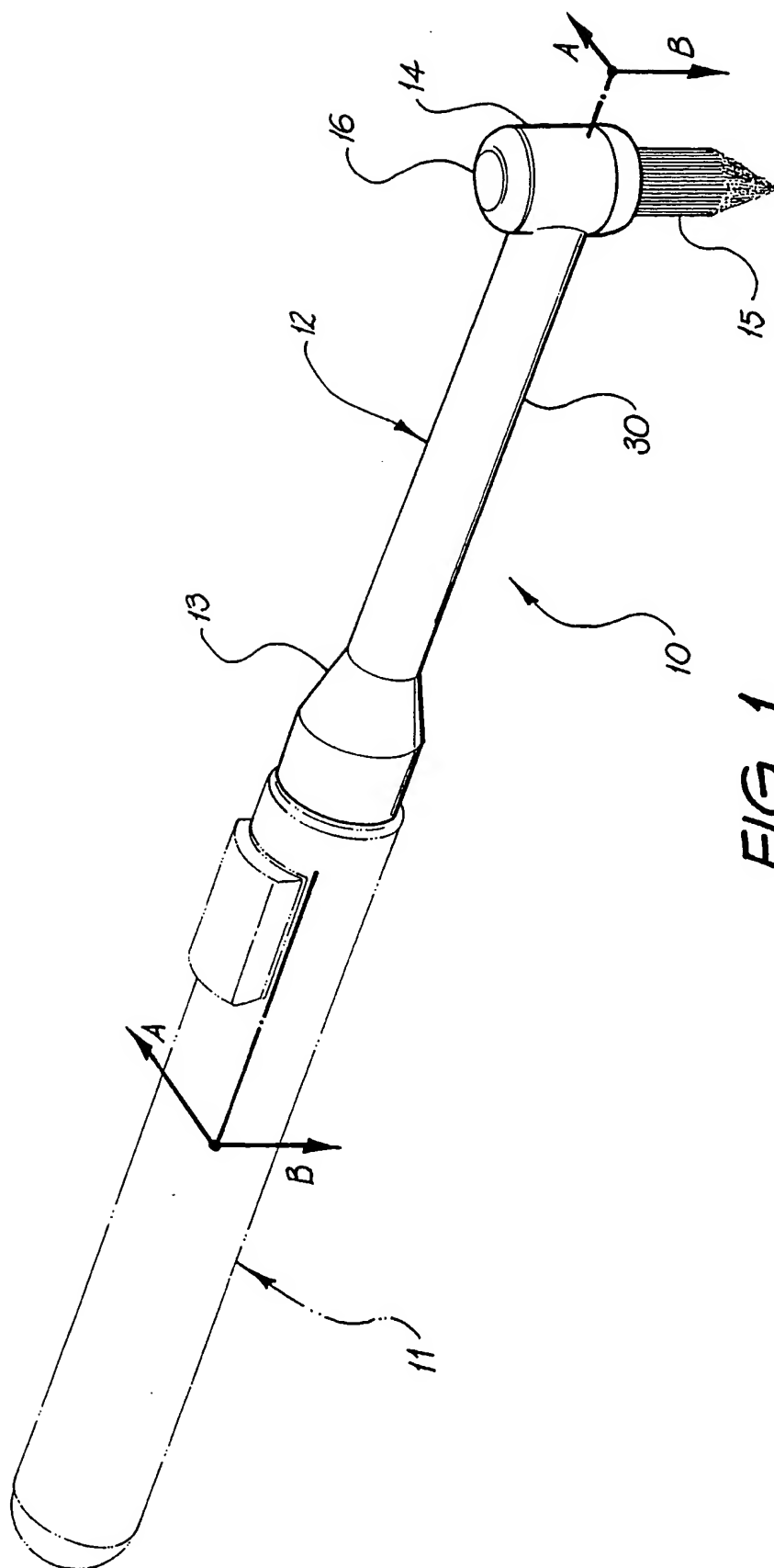
25 74. An electrically driven handpiece as claimed in any one of claims 41 to 73 wherein the head is joined to the mounting component.

75. An electrically driven handpiece as claimed in any one of claims 41 to 74 wherein the head comprises an array of bristle brushes mounted on a base.

30 76. An electrically driven handpiece as claimed in any one of claims 41 to 75 wherein the head comprises a shape formed from a flexible or absorbent material.

77. An electrically driven handpiece as claimed in claim 76 wherein the head is provided with a plurality of ribs, fluting or undulating surface features.

78. An electrically driven handpiece as claimed in any one of claims 41 to 76 wherein the angle of the oscillating arcuate motion of the head is up to 90°, preferably up to 45°.



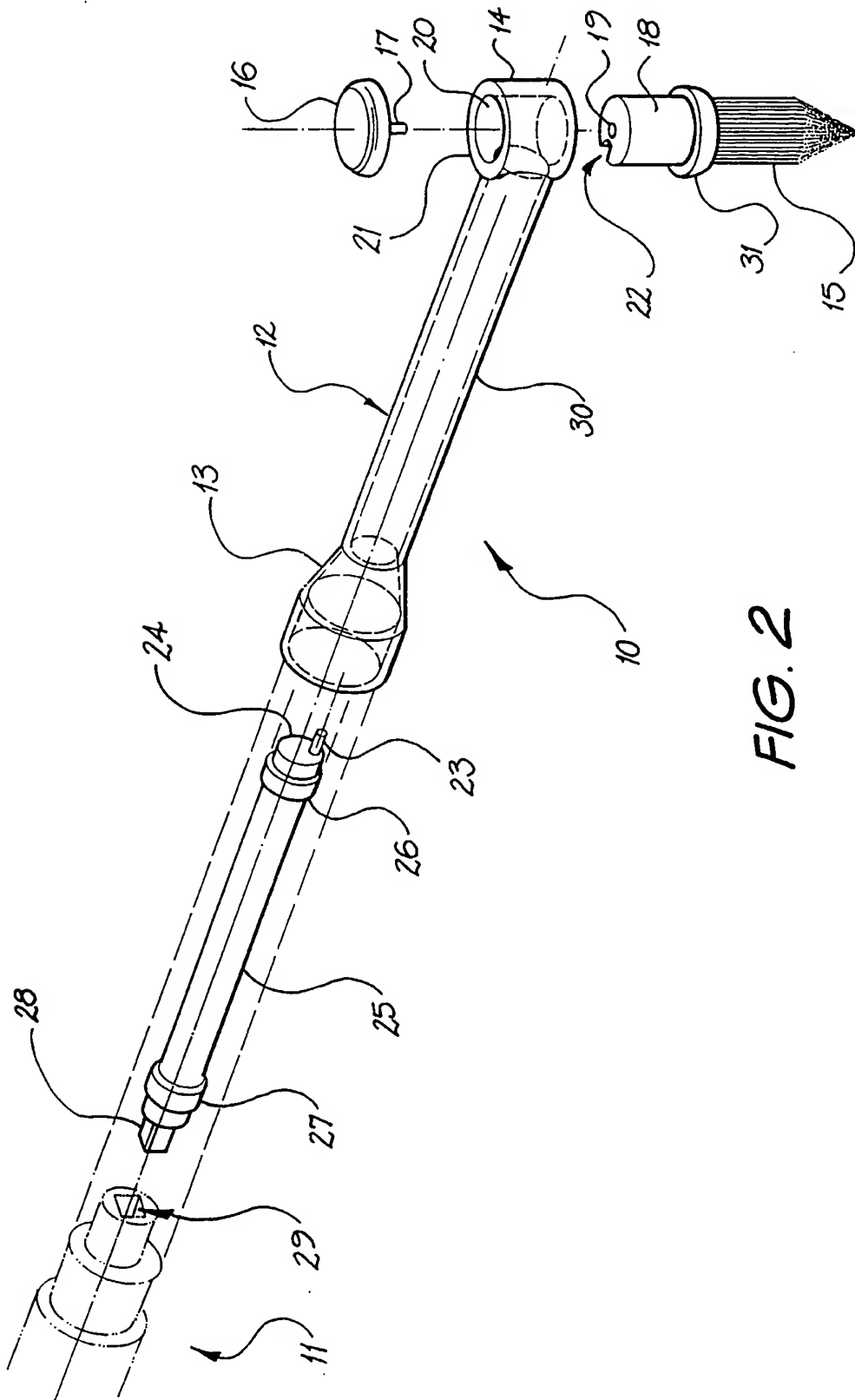


FIG. 2

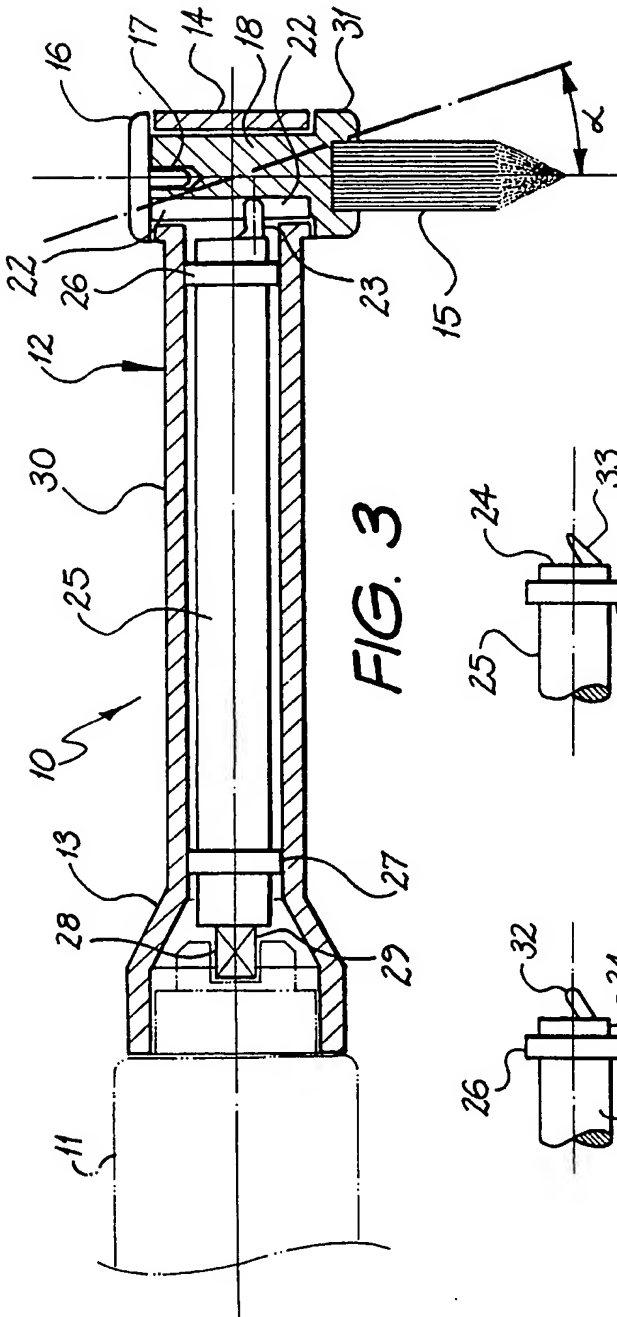


FIG. 3

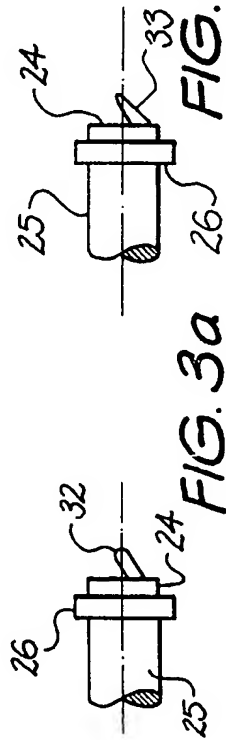


FIG. 3a FIG. 3b

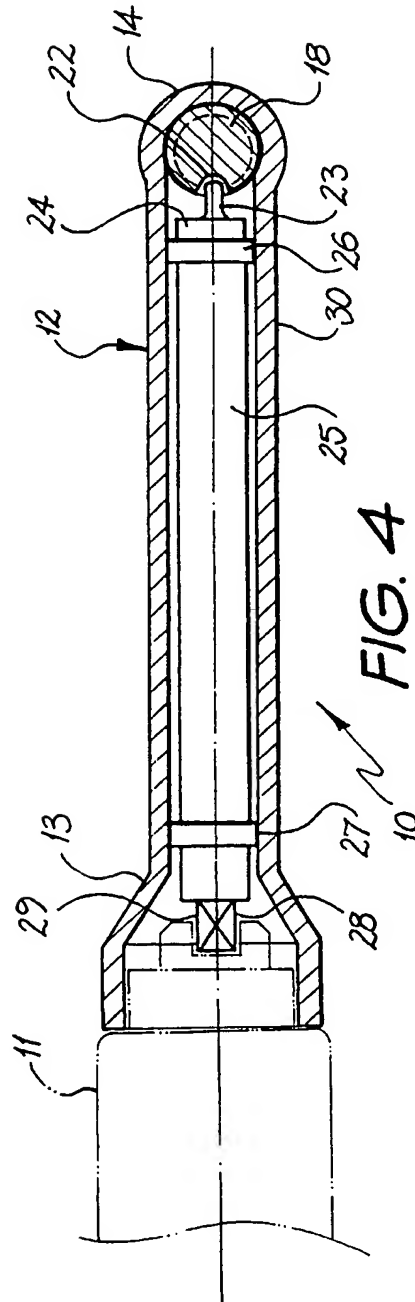


FIG. 4



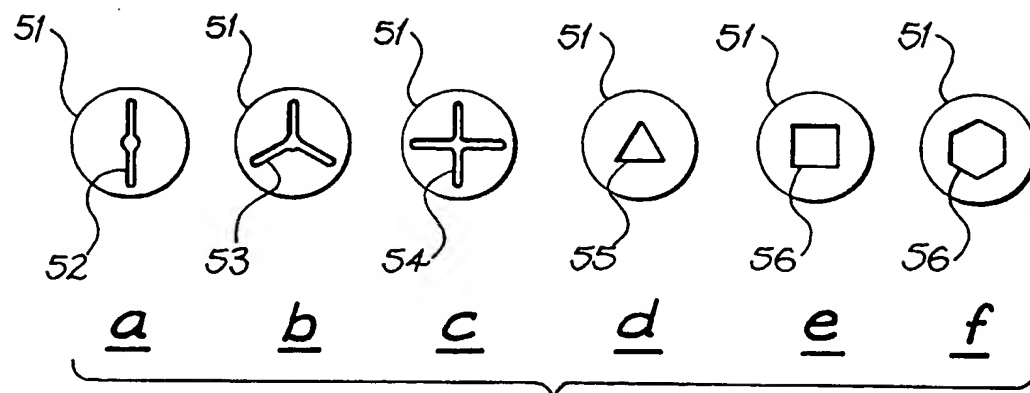


FIG. 5

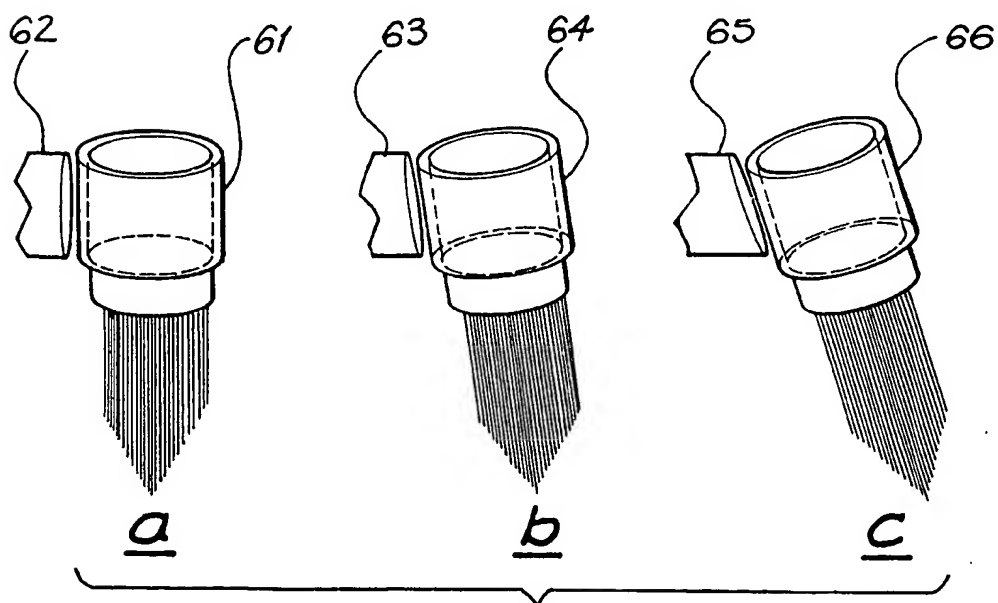


FIG. 6

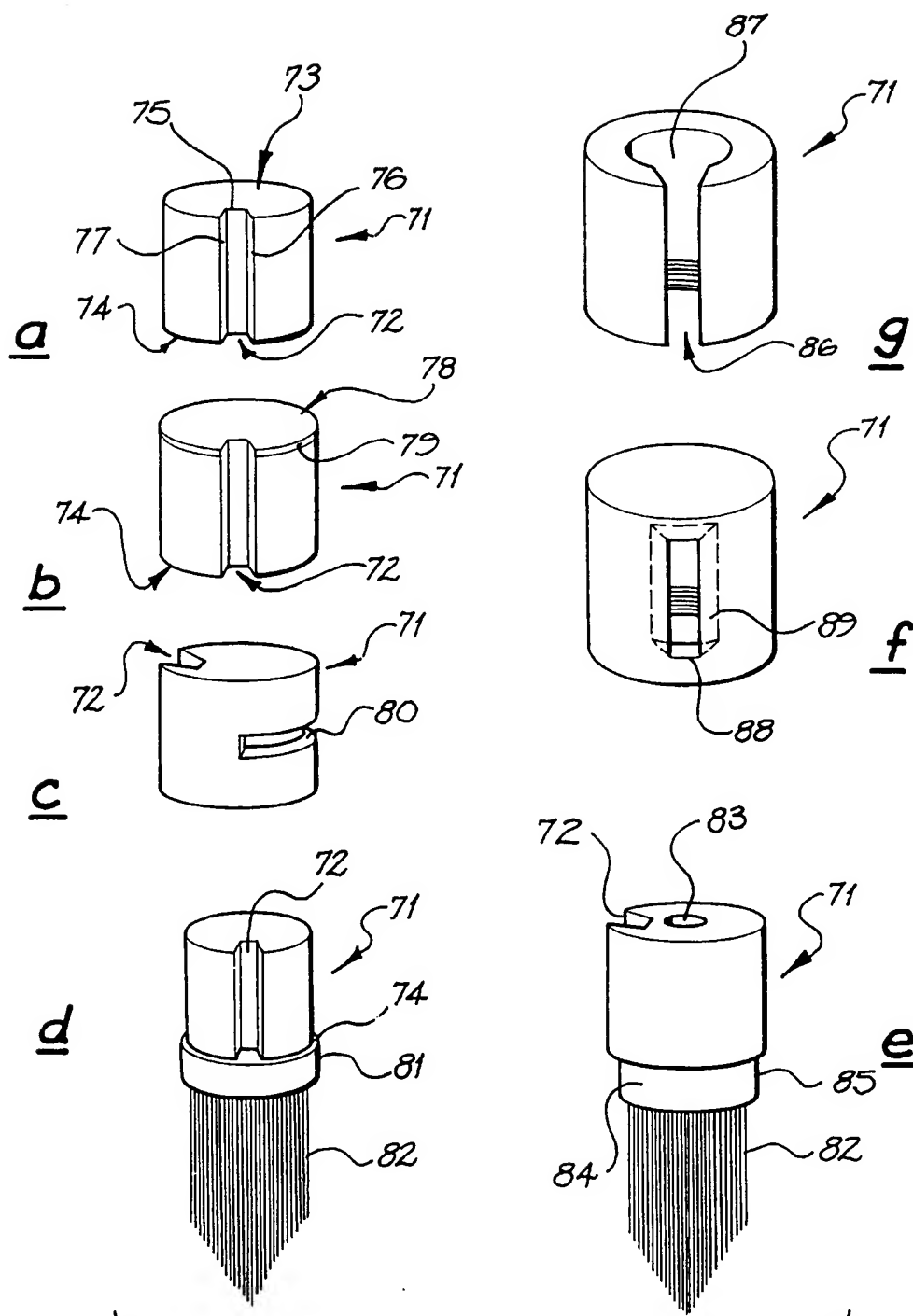
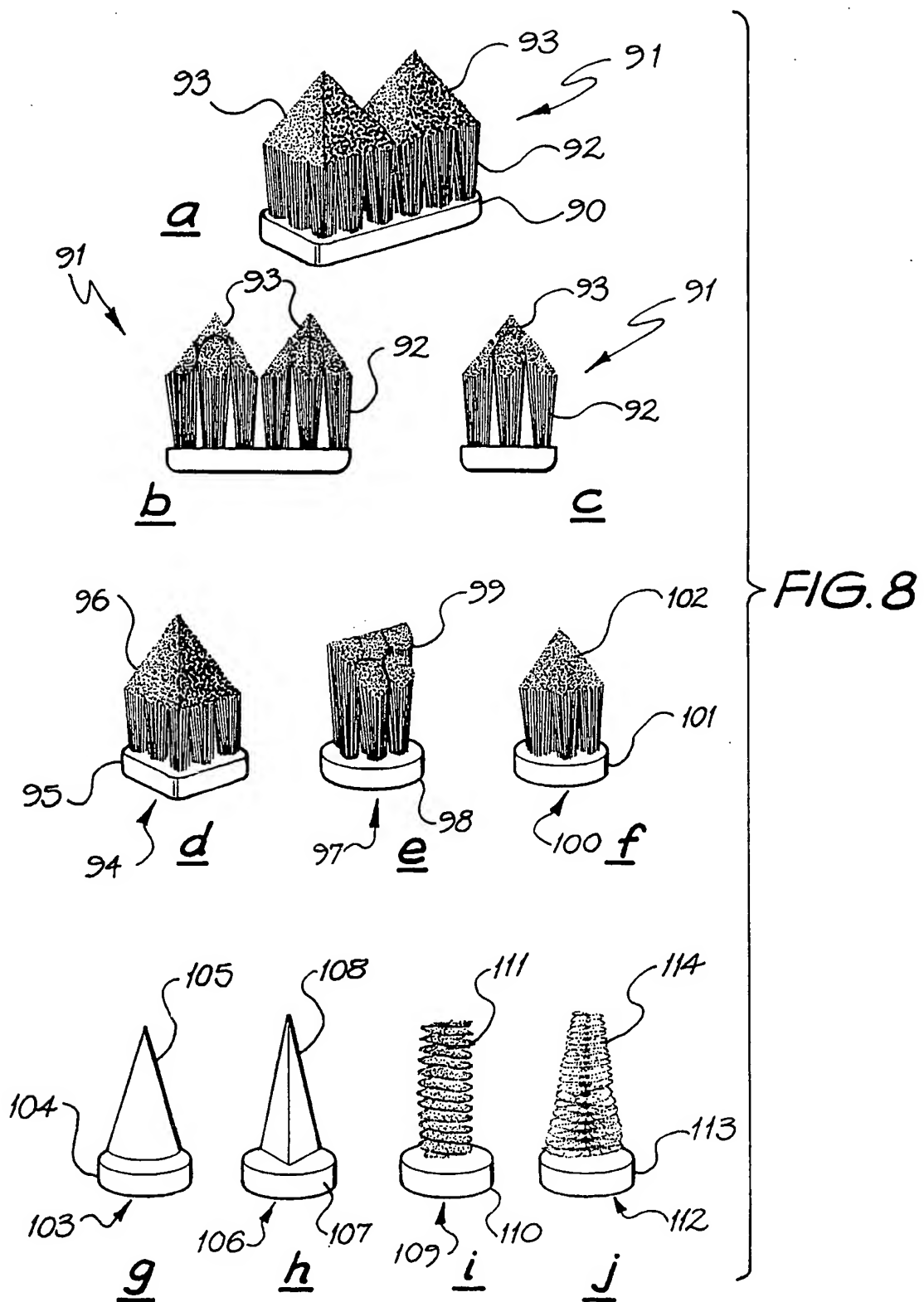
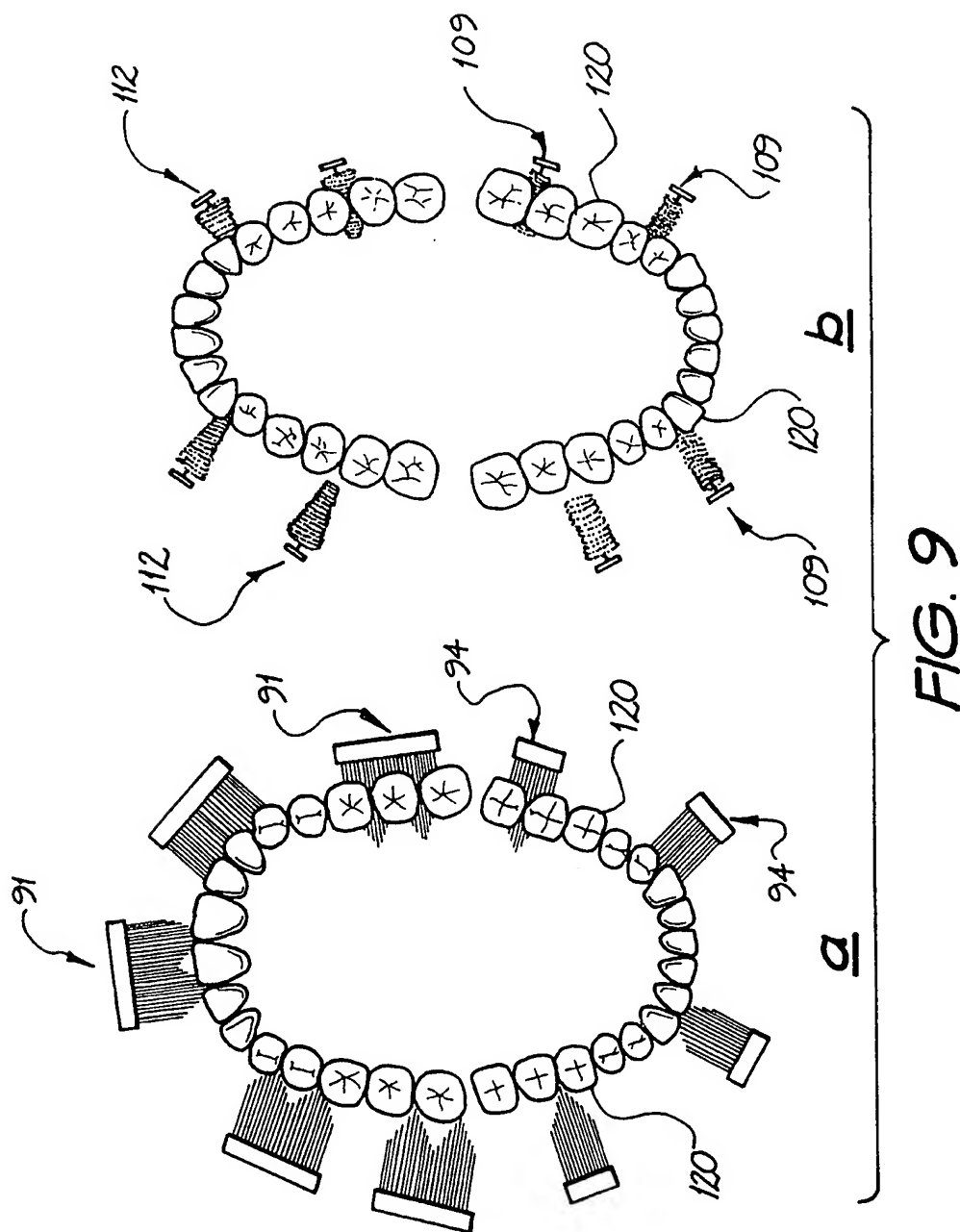
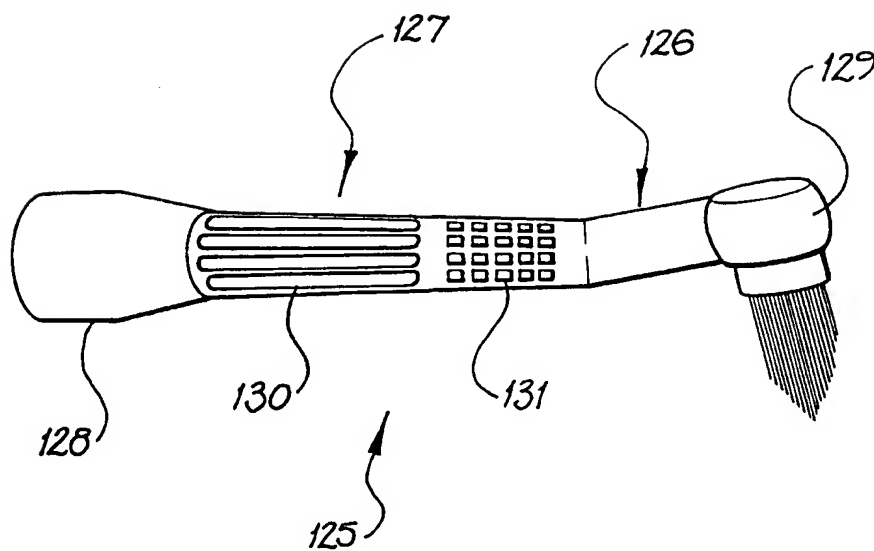


FIG 7





**FIG. 10**

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/AU 99/00446

**A. CLASSIFICATION OF SUBJECT MATTER**

Int Cl<sup>6</sup>: A61C 17/34

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC: A61C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
DERWENT, JAPIO: handpiece, handheld, tool instrument, brush, twist, oscillat., arc, agitat., reciproc., nutat., groove, slot, channel, cam, offset, eccentric

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 064 871 A (NAKANISHI DENTAL MFG. CO. LTD) 17 November 1982 Page 2, line 34 to Page 5, line 4 and figures	1-77
X	DE 195 09 840 (GEBR. BRASSELER GmbH & Co KG) 21 March 1996 Column 3, line 29 to Column 4, line 51 and Figures 1 to 3	1-77
X	CH 688 261 (WALKHOFF) 15 July 1997 Column 3, line 17 to Column 4, line 3 and Figures 4 to 5	1-77

☒ Further documents are listed in the  
continuation of Box C

☒ See patent family annex

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance  
"E" earlier application or patent but published on or after the international filing date  
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)  
"O" document referring to an oral disclosure, use, exhibition or other means  
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention  
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone  
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art  
"&" document member of the same patent family

Date of the actual completion of the international search  
30 July 1999

Date of mailing of the international search report  
- 6 AUG 1999

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU 99/00446

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97/39695 A (ANTHOGYR) 30 October 1997 Page 4, line 13 to Page 9, line 2 and Figures	1-77
A	WO 90/00885 A (WEISSMAN) 8 February 1990	
A	US 5 454 718 A (STROHMAIER) 3 October 1995	

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
**PCT/AU 99/00446**

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member	
EP	0 064 871	JP	57/185853	US	4 460 341
CH	688 261	DE	195 54 557		
WO	97/39695	FR	2 747 560		

END OF ANNEX